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several subjects, it should give each student a thorough drill in some one branch. The scheme has been thoroughly worked out on paper, but time alone can tell how it results. It must be said, however, that it has amply satisfied its advocates during the two years that it has been tried.

Hepaticæ Americanæ.—The first twenty numbers (Decades I. and II.) of this distribution, by Dr. L. F. Underwood and O. F. Cook, were received in the latter part of November. The species represented are as follows, viz.: 1. *Riccia natans* L.; 2. *Marchantia polymorpha* L.; 3. *Conocephalus conicus* (L.) Dum.; 4. *Anthoceros lævis* L.; 5. *Blasia pusilla* L.; 6. *Steetzia lyellii* Lehm.; 7. *Frullania grayana* Mont.; 8. *Lejeunia serpyllifolia* Lib., var. *Americana* Lindb.; 9. *Madotheca porella* (Dicks.) Nees.; 10. *Radula complanata* (L.) Dum.; 11. *Ptilidium ciliare* (L.) Nees.; 12. *Bazzania trilobata* (L.) B. Gr.; 13. *Trichocolea tomentella* (Ehr.) Dum.; 14. *Lepidozia reptans* (L.) Dum.; 15. *Kantia trichomanis* (L.) B. Gr.; 16. *Geocalyx graveolens* (Schrader.) Nees.; 17. *Cephalozia curvifolia* (Dicks.) Dum.; 18. *Fungermania schraderi* Mart.; 19. *Scapania nemorosa* (L.) Dum.; 20. *Plagiochila porellioides* Lindenb.

The specimens are carefully selected, and are neatly labelled. As will be seen, they represent the four orders of Liverworts, as well as all the larger genera. The set is well worth the price asked for it (\$1.25). It may be obtained of Dr. Underwood, at Syracuse, N. Y. Teachers of botany will find this set a valuable one for their beginning classes.—*Charles E. Bessey.*

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

The Sonora Earthquake of May 3, 1887.—On the afternoon of May 3, 1887, at 2.12 Pacific time (=120° W. of Greenwich), the first of a series of earthquake movements was felt in the State of Sonora and the adjacent parts of Mexico and the United States, over an area extending from El Paso in Texas on the east to the river Colorado and the Gulf of California on the west, and from the State of Sinaloa on the south as far north as Albuquerque in New Mexico; the extremes in both directions being over five hundred miles. It was the fortune of the writers to be at the time at the great copper-mining camp of Bisbee in Arizona, in a narrow gorge of the Mule Pass Mountains, about five thousand three hundred feet above the sea, and near the border of Sonora. A violent tremor of the earth, including two sharp shocks, and lasting over ninety seconds, was succeeded at fre-

quent intervals by many lesser movements in the next three days, and less frequently at least up to May 29. In this part of Arizona solid house-walls, of *adobe*, or unburned brick, were cracked or overturned, while huge rocks in the steep mountain gorges rolled down, causing much damage. Fires, perhaps kindled by these in their course, appeared immediately afterwards in various wooded regions in Sonora and Arizona, giving rise to many false rumors of volcanic eruptions. The movement here seemed from south to north; the Sonora railroad track in one place near the frontier, running east and west, was displaced three inches to the north; while a chimney-shaft, without being overturned, was turned violently around upon its base. The small town of Bavispe in the Sierra Madre, in Sonora, was nearly destroyed, many people being killed and wounded. Opoto suffered in a similar way, and Fronteras to a less extent. The district chiefly affected by the earthquake is, however, for the most part a desert, with some cattle-ranches and mining stations.

Interesting studies were made by the authors in the valleys, or *mesas*, between the parallel mountain ridges in this region, both in the San Pedro and Sulphur Spring Valleys. The latter, lying to the east of Bisbee, and stretching north and south about one hundred miles, is often eight or ten miles wide, and has its lower portion in Sonora. Though without a visible water-course, water is there generally found at depths of from ten to forty feet in the numerous wells sunk at intervals to supply the needs of large herds of cattle. As described by many observers, the surface of this plain was visibly agitated by the first earthquake shock, so that persons were in some places thrown down by the heaving of the soil, which burst open, with discharges of water, while the wells overflowed and were partially filled with sand. In the southern part of this valley, for about seven miles south from the Mexican frontier, the authors found the results of the undulatory movement of the soil apparent in great numbers of cracks and dislocations. For distances of several hundred feet, along some lines with a generally north and south course, vertical downthrows on one side, of from one foot to two feet and more, were seen, the depressed portion rising either gradually or by a vertical step to the original level. Branching, and in some cases intersecting, cracks were observed. These depressions were evidently connected with outbursts of sand and water, which, along cracks,—marked by depressions on both sides;—sometimes covered areas of many hundred square feet with layers a foot or more in depth, marked here and there by craters two feet or more in diameter, through which water had risen during the outburst of these mud volcanoes. The authors examined many of these phenomena in Northern Sonora, and took photographs, which were exhibited. They note that while the

earthquake movements in the adjacent hills of Palæozoic strata had left no marks, the dislocations over many square miles in the valley would have sufficed to throw down buildings and to cause great loss of life in an inhabited region. There are believed to be no evidences of previous earthquake disturbances in this region since its discovery by the Spaniards centuries ago.

From the published reports of commissioners named by the State of Sonora it appears that the regions injured by the earthquake are in two nearly parallel north and south valleys in the district of Moctezuma, along the river Bavispe, a tributary of the Yaqui. The town of Bavispe itself, of fifteen hundred souls, lies about seventy miles south of the American frontier and one hundred and ten miles southeast of Bisbee, Arizona; its elevation being three thousand and seventy feet above the sea. Here forty-two persons were killed and twenty-five wounded. Bacerao, twenty miles farther south, also suffered much damage, and the estimate for property destroyed in this valley was two hundred and eighteen thousand one hundred and ninety-nine dollars. Opoto, Guasalas, Granados, Bacudebachio, and Nacovi lie in a lower valley about thirty miles west of the last, the elevation of Guasalas being only seventeen hundred and twenty feet above the sea. The loss of life was here confined to Opoto, where nine were killed and six wounded. The injury done to property in this valley was estimated at seventy-eight thousand one hundred and fifteen dollars. In both regions are noticed the opening, in the arable lands, of numerous fissures, generally north or northeast in direction, from many of which water flowed abundantly. The river thus supplied in a time of excessive drought swelled to the volume usual in the rainy season of summer; a condition which lasted up to the time of the report of Señor Liborio Vasquez, dated at Bavispe, May 29, 1887. The fields had become green and the air moist with prevailing fogs. A report concerning the region of Opoto mentions not less than seven volcanoes in the vicinity, which were seen burning for two days, but without any flow of lava; while that for the Bavispe region declares that no volcano had there been discovered. The authors incline to the belief that, as was the case in the San José Mountains, and others examined by them along the borders of Arizona, the appearances of volcanoes near Opoto were due to forest fires.—*T. Sterry Hunt, LL.D., F.R.S., and James Douglas, M.A., Brit. Assoc. Adv. Science, Manchester, September, 1887. Abstract.*

Crinoid Beds at Crawfordsville, Indiana.—The principal belt of bed-rock running through Montgomery County, Ind., belongs to the Keokuk group of the Subcarboniferous period: it is in this formation that the celebrated crinoid beds are situated.

Below the Louisville, New Albany and Chicago railroad-bridge,

on the north bank of Sugar Creek, section 29, township 19 north, range 4 west, is seen a high bluff of sandstone, which has been left exposed by excavation. This sandstone forms the roof of the crinoid beds and overlies the blue shale in which the crinoids are found. These beds were discovered by the late Prof. E. O. Hovey, of Wabash College, in 1836. He first noticed the shale, which seemed to be full of crinoid stems and shells; he collected a number of these and exhibited them to his classes in college, afterwards he called public attention to them.

In 1842, Horace C. Hovey, son of Prof. E. O. Hovey, began to collect these crinoidal fragments, and while he was thus engaged he found the first crinoid head found at these beds. This specimen was an *Actinocrinus*.

Mr. R. K. Krout and Mr. Ira Crane visited these banks in the year 1851, and collected quite a number of specimens. Mr. Crane found, in the ravine, one of the finest specimens of *Onychocrinus exsculptus* that has ever yet been found; this specimen was pictured in the *Scientific American* of July 12, 1887.

Mr. O. W. Corey was the next person to visit the banks. He was an excellent machinist, but nature seems to have intended him to follow the "bent of his genius" in digging crinoids. He found first impressions of crinoids in the sandstone. This led him to think that below this sandstone, in the blue shale, specimens might be preserved, so he at once set to work, dug below this sandstone, and opened up a bed of fossils that has never yet had an equal. His first collection was bought for Wabash College by Horace C. Hovey, who raised the money by solicitation. Mr. Corey then discovered other places near this bed, and opened them also. From his labors the beds bear his name, and are known as Corey's Bluff.

Yale College hearing of Mr. Corey's career, at once set Professor Bradley at work. Professor Bradley was then working for Horace C. Hovey, when he was engaged by Professor Marsh, of Yale College.

Charles Dyer, an Englishman, who lived near Cincinnati, came here, and bought specimens and shipped them to the British Museum.

The beds were then purchased by Professor Bassett, who has taken out many hundreds of fine specimens.

The following is a list of the species of the Crinoidea found at this locality:

- 1881. *Agaricocrinus springeri* White. Ind. Rep., 1881.
- 1868. *Barycrinus herculeus* Meek and Worthen (*B. hoveyi* var. *herculeus*). Ill. Rep., vol. v.
- 1861. *Barycrinus hoveyi* Hall (*Cyathocrinus hoveyi*). Ill. Rep., vol. v.
- 1859. *Batocrinus indianaënsis* Lyon and Cassiday (*Actinocrinus indianaënsis*). Ill. Rep., vol. v.

1880. *Batocrinus wachsmuthi* White (*Actinocrinus wachsmuthi*). Ind. Rep., 1879-80.
1869. *Calceocrinus bradleyi* Meek and Worthen. Ill. Rep., vol. v.
1868. *Catillocrinus bradleyi* Meek and Worthen. Ill. Rep., vol. v.
1865. *Cyathocrinus arboreus* Meek and Worthen. Ill. Rep., vol. iii.
1879. (?) *Cyathocrinus harrisi* S. A. Miller. Journ. Cincin. Soc. Nat. Hist., vol. ii.
1869. *Cyathocrinus inspiratus* (?) Lyon. Trans. Amer. Philos. Soc., vol. xiii.
1859. *Cyathocrinus multibrachiatus* Lyon and Cassiday. Amer. Journ. Sci., vol. xxviii.
1870. *Cyathocrinus poterium* Meek and Worthen. Ill. Rep., vol. v.
1860. *Dichocrinus ficus* Cassiday and Lyon. Ill. Rep., vol. v.
1860. *Dichocrinus polydactylus* Cassiday and Lyon. Proc. Amer. Acad. Arts and Sci., vol. v. Syn. *expansus* Meek and Worthen. Ill. Rep., vol. v.
1858. *Forbesiocrinus wortheni* Hall. Rep. Iowa, vol. ii. part ii.
1859. *Ollacrinus tuberosus* Lyon and Cassiday (*Goniasteroidocrinus tuberosus*). Amer. Journ. Sci. and Arts, vol. xxviii.
1859. *Onychocrinus exsculptus* Lyon and Cassiday. Syn. *Onychocrinus* (*Forbesiocrinus*) *norwoodi* Meek and Worthen. Ill. Rep., vol. ii.
1859. *Onychocrinus ramulosus* Lyon and Cassiday. Amer. Journ. Sci., vol. xxviii.
1865. *Platycrinus hemisphericus* Meek and Worthen (*Pleurocrinus*). Ill. Rep., vol. iii.
1870. *Poteriocrinus concinnus* Meek and Worthen (*Pot.* (*Zeacrinus*) *concinnus*). Ill. Rep., vol. v.
1870. *Poteriocrinus* (*Decadocrinus*) *depressus* Meek and Worthen (*Scaphiocrinus depressus*). Ill. Rep., vol. v.
1869. *Poteriocrinus* (*Scaphiocrinus*) *coreyi* Meek and Worthen. Rep. Ill., vol. v.
1878. *Poteriocrinus* (*Scaphiocrinus*) *gibsoni* White. Proc. Acad. Nat. Sci. Phil.
1879. *Poteriocrinus* (*Scytalocrinus*) *grandis* Wachsmuth and Springer, described as *Poteriocrinus coreyi*. Ill. Rep., vol. vi.
1878. *Poteriocrinus* (*Scaphiocrinus*) *gurleyi* White. Proc. Acad. Nat. Sci. Phil.
1865. *Poteriocrinus* (*Scaphiocrinus*) *Indianaënsis* Meek and Worthen. Ill. Rep., vol. iii.
1861. *Poteriocrinus nodobrachiatus* Hall. Bost. Journ. Nat. Hist., p. 614.
1861. *Poteriocrinus* (*Scytalocrinus*) *robustus* Hall. Bost. Journ. Nat. Hist., p. 315.
1879. *Poteriocrinus* (*Pachylocrinus*) *subæqualis* Wachsmuth and Springer. Ill. Rep., vol. v.
1861. *Poteriocrinus* (*Scaphiocrinus*) *unicus* Hall. Ill. Rep., vol. v.

1858. *Taxocrinus multibrachiatus* Lyon and Cassiday (labelled in most Amer. collections *Forbesiocrinus meeki* Hall). Amer. Journ. Sci., vol. xiii.
1861. *Vaxocrinus lyoni* Hall (*Cyathocrinus lyoni*) Meek and Worthen. 1868 (*Barycrinus lyoni*). Proc. Acad. Nat. Sci. Phil. Syn. *Cyathocrinus hexadactylus*.—Chas. S. Bechler.

The Carboniferous Genus *Stereosternum*.—The reception of a nearly entire specimen of the remarkable reptile *Stereosternum tumidum* Cope, from San Paolo, Brazil, through Professor Orville Derby, enables me to add a number of characters to those already known. The sternal region presents a large coracoid on each side posteriorly, and a transverse element anteriorly. Whether the latter is clavicle or the transverse limbs of a large interclavicle, is uncertain. The foramen of the humerus is *external*. The carpus consists of a radiale, a large intermedium, and a small ulnare; a large centrale and four tarsalia, the external related to two metapodials. The thumb is more robust than the four other digits. The neck is moderately elongate, and includes nine vertebræ besides the atlas. The vertebræ have robust transverse processes and slender cervical ribs. The skull is elongate and acuminate, and its bones are apparently fragile. Little of its structure can be made out. The teeth are slender, acute, and nearly straight, and are planted in (?) shallow alveoli.

The characters of the scapular arch differ from those of the Theromorpha. This character, with the different tarsus and rib-articulation, indicates that Dr. Baur's order Proganosauria, proposed for this type, is well founded. The lacertilian character of the ectepicondylar foramen of the humerus must be also remembered.—*E. D. Cope*.

MINERALOGY AND PETROGRAPHY.¹

Petrographical News.—In an exceedingly interesting paper recently published, Dr. A. Lagorio² discusses some of the fundamental principles relating to the nature of the glassy base of porphyritic rocks, the succession of crystallization in rock-magmas, and the classification of rocks. He emphasizes the thought that the geologist must ask the aid of chemistry and physics in solving the problems which present themselves to him. He must obtain all the light that these kindred sciences can lend him, and in this light must approach the hidden mysteries locked up in the depths of rock-masses, and must examine them with the critical eyes not merely of the geologist, but of the chemist and physicist as well. We may then, he thinks,

¹ Edited by DR. W. S. BAYLEY, Madison, Wisconsin.

² Miner. u. Petrog. Mitth., viii., 1887, p. 422.